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Toxicological Assessment of Tartrazine on Seed Germination Capacity of *Vigna radiata* (L.)

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Abstract
Tartrazine is a water soluble organic azo dye widely used in food products, drugs and cosmetics. Tartrazine has been assessed for its toxicity on different animal models. In the present study, tartrazine has been checked for its toxicity on the seed germination capacity in *Vigna radiata* (L.). For this assessment, *Vigna* seeds were exposed to two different test concentrations of tartrazine (0.05 and 0.1 ppm). Results revealed toxic nature of tartrazine on seed germination of *Vigna radiata* as revealed by reduced germination percentage and mean root length.
Keywords: Tartrazine, toxicity, *Vigna radiata*, germination, green gram, mung bean

INTRODUCTION

Tartrazine is an organic azo dyes widely used in food products, drugs and cosmetics [1]. Various types of medications include tartrazine to give a yellow, orange or green hue to a liquid, capsule, pill, lotion, or gel, primarily for easy identification. Tartrazine appears to cause the most allergic and intolerance reactions of all the azo dyes, particularly among asthmatics. Different studies have evaluated the toxicity of tartrazine on different animal models [1-4]. *Vigna radiata* (L.), also known as mung bean has been used as a model for assessing the toxicity of different chemicals [5-7]. Effects of nano silver oxide and silver ions on growth of *Vigna radiata* has also been assessed [8]. In the present study, an attempt has been made to assess the toxicity of tartrazine dye on the germination capacity of seeds of greengram, *Vigna radiata.*

MATERIALS AND METHODS

Test materials and solutions

Tartrazine dye (10 g packing) under the trade name Ajanta and green grams were purchased from the local market. Two test concentrations C1 and C2 were formulated. First test concentration (C1, 0.05 ppm) was made by dissolving 0.5 g Tartrazine in 10 ml distilled water. Second test concentration (C2, 0.1 ppm) was made by dissolving 1.0 g Tartrazine in 10 ml distilled water.

Experimental setup

Seeds of *Vigna radiata* were kept in petri dishes at room temperature for 5-6 hours for drying and the batch was segregated in three groups of 50 g each. Every group was kept in different petri dishes. 10 ml distilled water was added to petri dish 1 (Group 1) and was kept as control in a dark place. To the second group of *Vigna radiata* seeds, 10 ml test concentration solution C1 was added and similarly, test concentration solution C2 was added to group 3. All the seed groups were kept in dark for 3 days in dark place to observe the percentage germination and root lenght.

RESULTS AND DISCUSSION

Vigna radiata seeds were kept in three groups viz. Group 1, 2 and 3 and were added distilled water, test concentration C1 and C2, respectively as discussed in experimental setup section. Table 1 shows the exposure given in all the 3 groups and the percentage germination observed.

Percentage germination

All the seed groups were observed for percentage germination after the exposure of 3 days to the test concentrations. The percentage germination was found to be 90% in case of group 2 which was exposed to a 0.05 ppm tartrazine with a reduction of 10% was found. On the other hand a zero percent germination was seen after 3 days following the exposure of 0.1 ppm tartrazine. A

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100% germination was found in control group 1 (Figure 2). On the same line, a concentration as low as 1 µM lead is highly toxic to plants. The relative fresh mass of cowpea (*Vigna unguiculata*) was found to be reduced by 10% at a Pb^{2+} activity of 0.2 µM for the shoots and at a Pb^{2+} activity of 0.06 µM for the roots [9].

On the contrary, tartrazine were administered twice, at 24h intervals, by oral gavage to mice and assessed in the in-vivo gut micronucleus test for genotoxic effects (frequency of micronucleated cells) but tartrazine did not induce genotoxic effect in the micronucleus gut assay in mice at doses up to 2000 mg/kg b.w. [10]. Another study investigated the interaction of native calf thymus DNA with tartrazine in 10 mM Tris-HCl aqueous solution at neutral pH 7.4. Tartrazine molecules were found to bind to DNA via groove mode [11].

Table 1. Exposure treatments and percentage germination in three groups of *Vigna radiata*.

Seed Group	Test concentration	Exposure concentration	Exposure time	Germination %
Group 1	-	-	3 d	100%
Group 2	C1	0.05 ppm	3 d	90%
Group 3	C2	0.1 ppm	3 d	NIL

ppm, parts per million; **d,** days

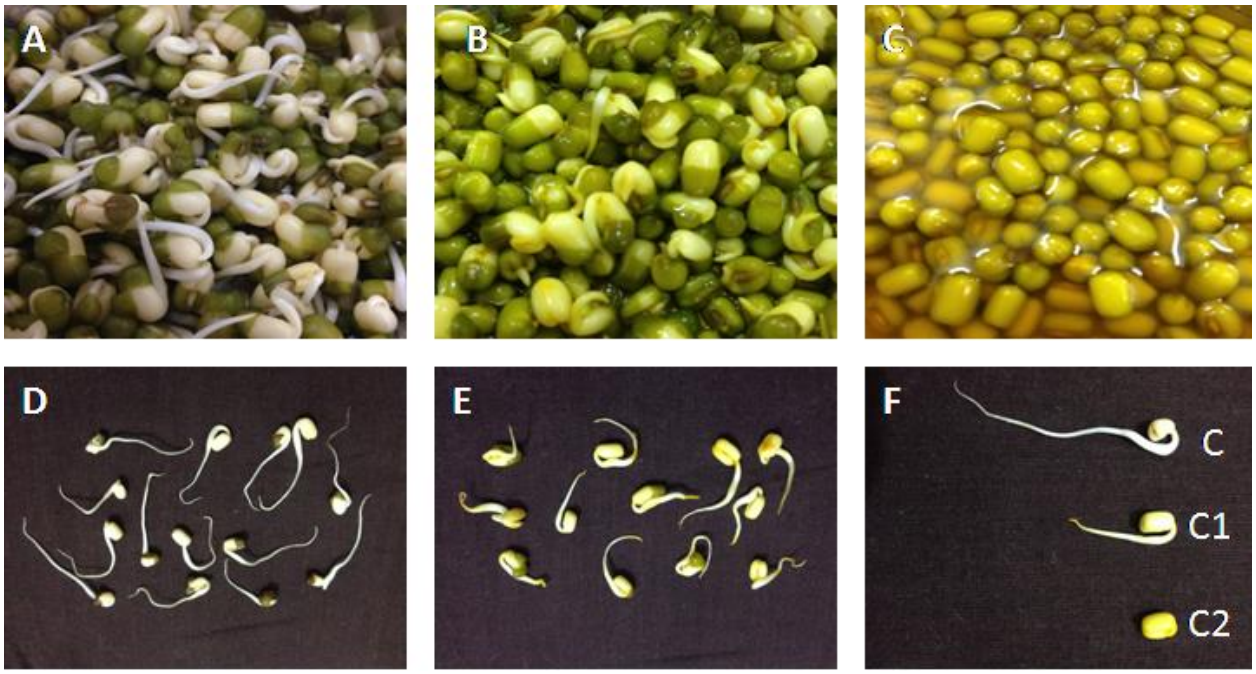

Figure 1. Comparative root lengths in *Vigna radiata* seedlings exposed to different test concentrations. **A,** Control group of seedlings. **B,** Group 2 seedlings exposed to 0.05 ppm tartrazine. **C,** Group 3 seedlings exposed to 0.1 ppm tartrazine. **D,** Germinated control seeds. **E,** Germinated group 2 seeds. **F,** Comparative root lengths after exposure to different test concentrations (C, Control; C1 and C2, test concentrations)

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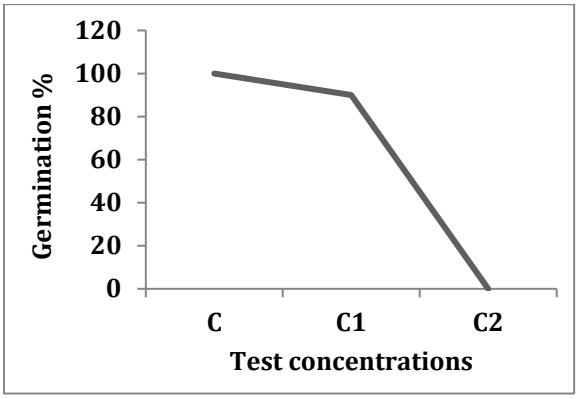

Figure 2. Percentage germination after exposure to different test concentrations. C, control group

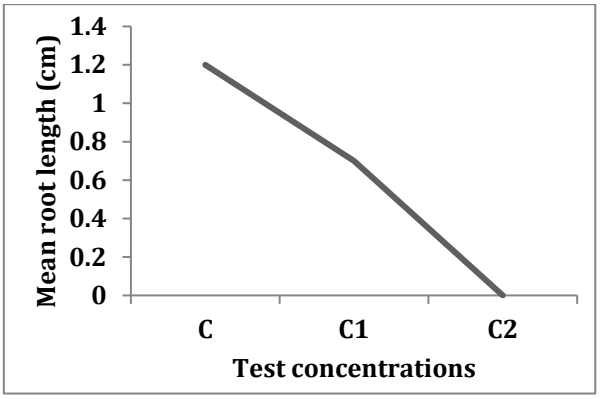

Figure 3. Mean root length after exposure to different test concentrations. C, control group

Root length measurements

All the groups were screened for a mean root length. An average root length was measured taking ten root length observations. Mean root length came out to be 1.2 cm in control group (G1)(Figure 1, A and D). Group 2 exposed to 0.05 ppm tartrazine showed a mean root length of 0.7 cm (Figure 1, B and E) whereas in group 3, a zero mean root length was found (Figure 1, C). Figure 1F and 3 shows the comparative root lengths in the seedlings exposed to different test concentrations. Similarly, a study found the relative fresh mass of cowpea to be reduced by 10% at a Pb^{2+} activity of 0.06 µM for the roots [9]. Another study confirms the toxic effects of low concentrations of Cu on nodulation in *Vigna unguiculata* [12]. Fe-status plays a significant role in ameliorating the Cd toxicity. Responses to four such Fe/Cd conditions were evaluated in a study. Oxidative stress was generated in the presence of Cd, followed by a decrease in Fe and an increase in Cd concentrations in green gram (*Vigna radiata*). On the other hand, supplementation with Fe had a protective effect against Cd toxicity in *Vigna radiata* [13]. The present study also confirms the toxicity of tartrazine on the germination capacity in seedlings of *Vigna radiata*.

CONCLUSION

Tartrazine is a water soluble organic azo dye widely used in food products. Toxicity of tartrazine was assessed following two test concentrations on seedlings of *Vigna radiata*. A lower germination percentage and mean root length were observed in the study. The present study confirms the toxicity of tartrazine on the germinating capacity of seedlings of *Vigna radiata*.

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